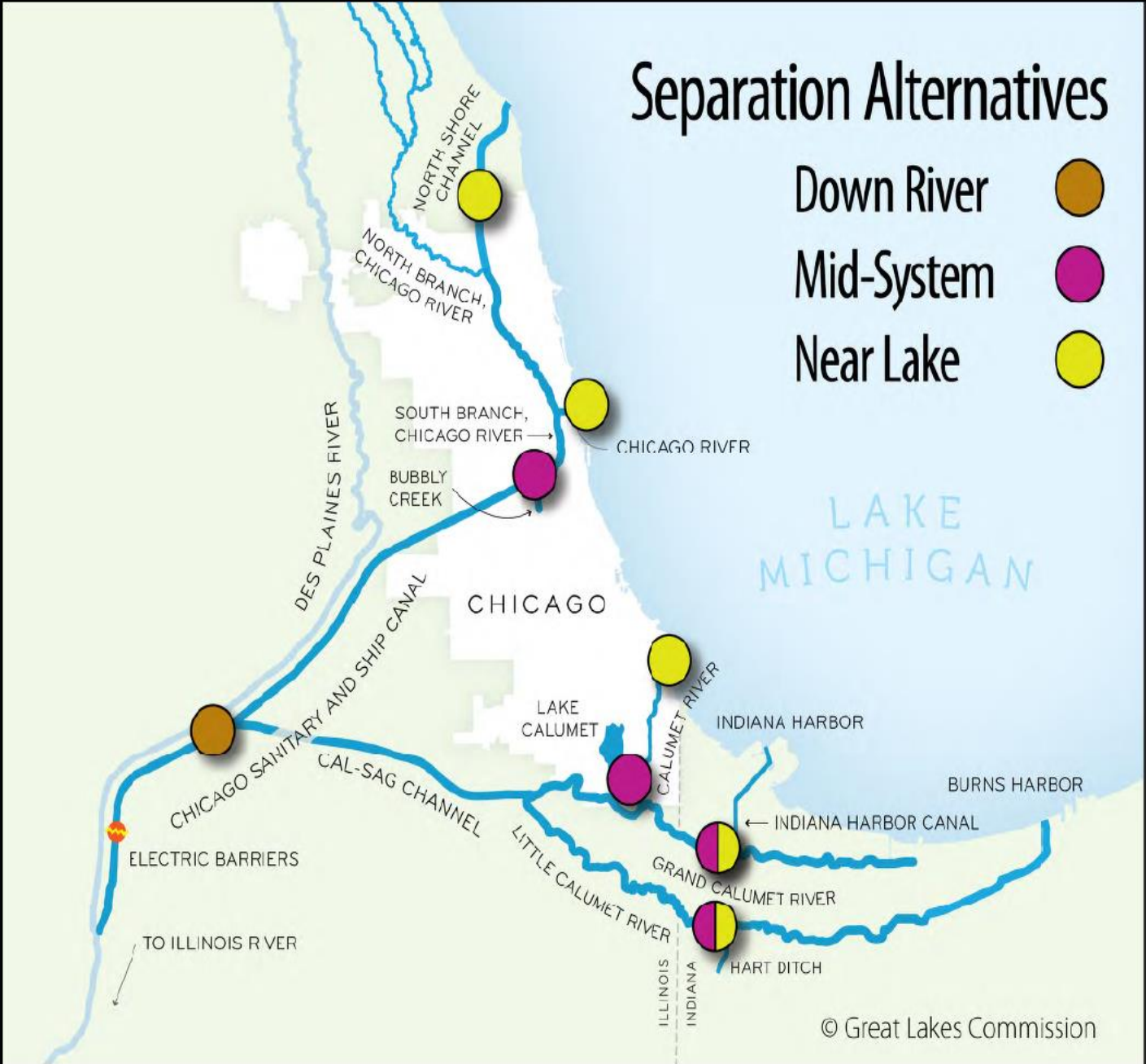


# Separation Alternatives

Down River 

Mid-System 

Near Lake 



# Chicago Area Waterways System (CAWS) Discussion Framework



**Update on the AIS Lock Treatment System  
following review by the Corps  
Engineer Research and Development Center  
(ERDC)**

David A. Hamilton  
The Nature Conservancy  
July 26, 2018

# Chlorination Lock to Control Aquatic Invasive Species Migration – A Research Project Exploring Feasibility

**Victor F. Medina, Ph.D., P.E.**

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**David A. Hamilton**

The Nature Conservancy



US Army Corps  
of Engineers.

**ERDC**

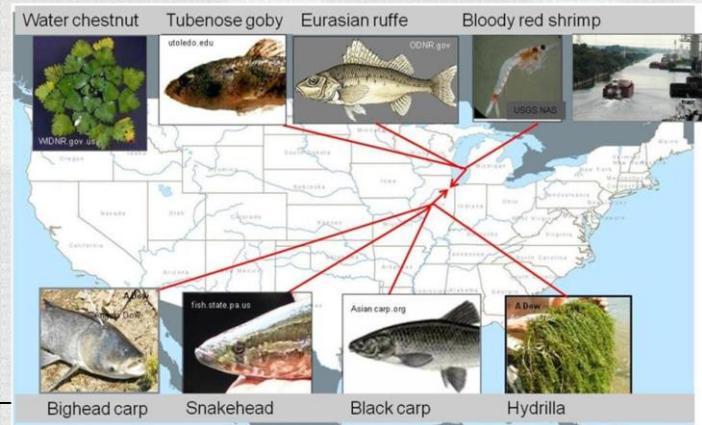
Engineer Research and  
Development Center

# Problem

- The Chicago Area Waterways System (CAWS) may allow AIS to move from the Mississippi to the Great Lakes (GL) & back.
- Electric/sonic fish barriers are “leaky” and can allow some fish to pass, and target only fish species.
- There are other AIS not affected by electrical barrier.
- Barriers are designed to work one way, but there are invasive opportunities of GL species to the Mississippi.
- Electrical barriers can be a health hazard if someone should fall in.



29 species currently poised to invade Mississippi River via canal

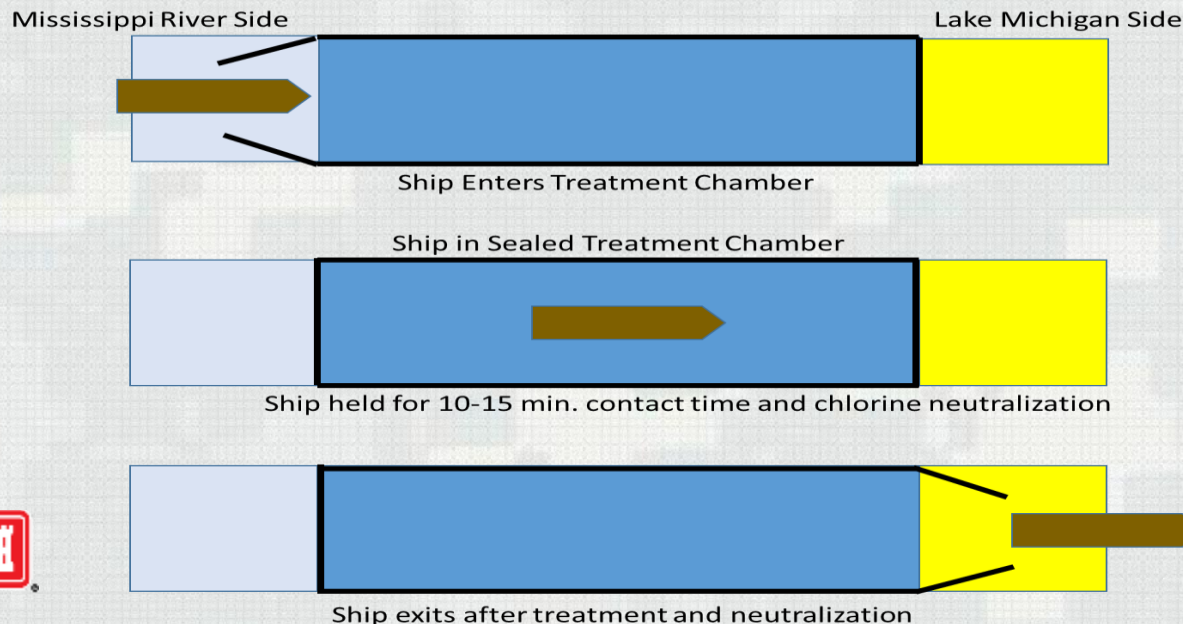


10 species currently poised to invade Great Lakes via canal



# Solution

The Nature Conservancy (TNC) has proposed an alternative, the establishment of a chemical chamber. This involves using the chamber as a reactor, in which shipping will be treated with chlorine. ERDC has been partnering with TNC to evaluate this interesting concept.



# Why was Chlorine selected?

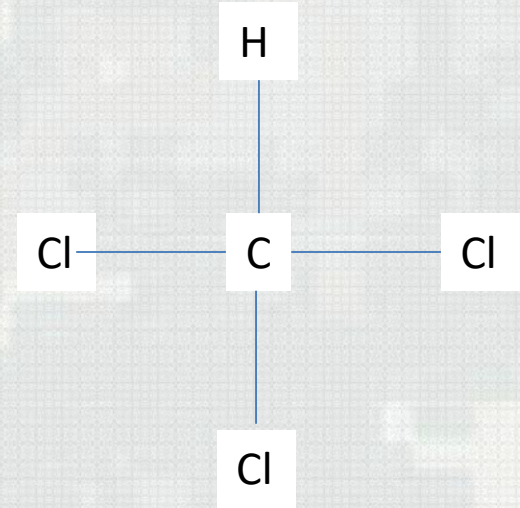
- Other possibilities include ozone, high temperature, menadione, reactive oxygen species, high salt concentration.
- Rapidly lethal to a wide range of aquatic taxonomic groups (invertebrates, fish, and plants) and life stages
- Widely used for drinking water treatment, swimming pool and skin contact, pesticide application
- Safely used. There is a great deal of experience on the safe application of chlorine.
- Attenuation – will attenuate naturally. Can be chemically attenuated




Total Residual Concentration (mg/l) that causes 100% mortality					
Species	size	exposure time (min)	18 °C	22 °C	28 °C
Bighead carp	4 to 8 inch	10			10
Bighead carp	4 to 8 inch	20		10	
Bighead carp	4 to 8 inch	60	10		
Silver carp	4 to 8 inch	10		10	
Silver carp	4 to 8 inch	20	10		
Daphnia		10	10		

# Challenges

- Lack of 100% mortality data
- Adaptive responses
- Transformation products
- Less than 100% containment of chlorine
- Corrosion
- Regulatory approval
- Potential for vaporous release
- Dealing with dead organisms
- Transformation Products
- Effective mixing (dead zones)
- Are there alternative chemical treatments that should be considered?



ERDC WQTN-18-1  
January 2018



Evaluation of a Proposed Chemical Treatment Lock for the Control of Aquatic Invasive Species in the Chicago Area Waterway System (CAWS)  
by Victor F. Medina, Jack Killgore, and Jan Jeffrey Hoover

**PURPOSE:** The purpose of this report is to review the concept of developing a special channel near the Chicago Area Waterway System (CAWS) to treat ship and barge traffic headed towards Lake Michigan with chlorinated water, minimizing the movement of aquatic invasive species (AIS) into the Great Lakes. This concept was proposed in a white paper titled *Conceptual Aquatic Invasive Species Treatment System for the Chicago Area Waterways*, which was prepared by CH2M for the Nature Conservancy (CH2M 2016). Victor Medina is an environmental engineer with a strong background in water treatment including disinfection. Jack Killgore and Jan Jeffrey Hoover are research fishery biologists who are experts in AIS, particularly the Asian Carp. All are members of the Environmental Laboratory (EL) of the U.S. Army Engineer Research and Development Center (ERDC).

This project identifies several critical concerns that should be considered before pursuing such a course. All issues could be conceivably addressed with additional studies and/or extensive engineering. That said, some of the identified issues may be challenging to overcome.

**BACKGROUND**

**The Chicago Area Waterway System (CAWS):** The CAWS is a complex series of natural and man-made waterways and canals, including the Chicago River, the Chicago Sanitary and Ship Canal (CSSC), the Cal-Sag Channel, and the Calumet River (Figure 1). The system dates back to 1900 and was designed to move stormwater and treated sewage away from the City of Chicago's water supply to the Des Plaines River, which ultimately connects to the Illinois River and then to the Mississippi River (Duncker 2011). The CAWS also allows barge traffic to move from the Mississippi River to Lake Michigan through a series of locks and dams. There is concern that the CAWS serves as a conduit to allow AIS to move from the Mississippi to the Great Lakes (USACE 2014). Two groups of species are of particular concern: the Asian Carp, or bigheaded carp (genus – *Hypophthalmichthys*, there are three species) and the *Apocorophitum lacustris*, a shrimp like amphipod which is commonly referred to as a scud (USACE 2014).

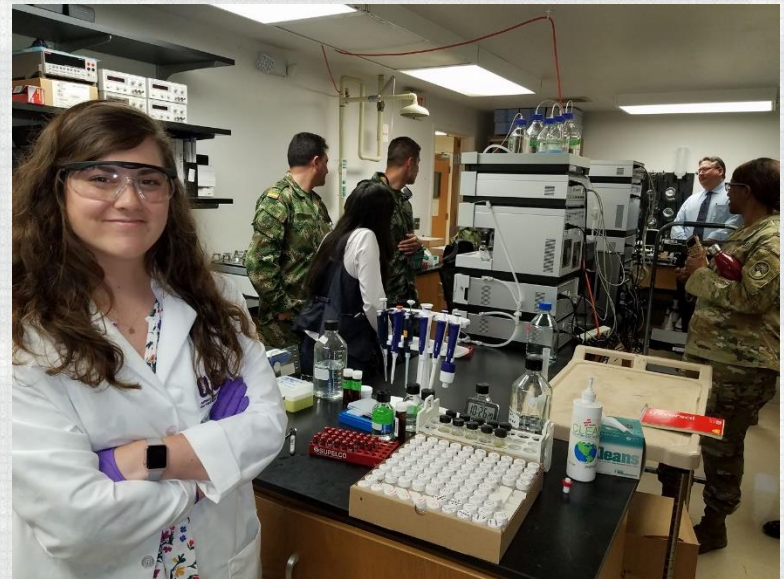
Electric fish barriers were constructed in the CSSC near Romeoville to reduce, and possibly prevent, movement of invasive species between Lake Michigan and the Illinois River system (Figure 1). These barriers are currently in operation based on research results from ERDC (Holliman et al. 2016). However, there is concern that barge traffic can warp the electrical field and small fish can be entrained between barges even while immobilized. A more extensive set of alternatives using both electrical and acoustic deterrents (complex acoustics may result in

Approved for public release; distribution is unlimited.



# Recommended studies in support of evaluation/application

- Targeted toxicity studies on specific species of interest, range of ages, and to 100% mortality endpoint.
- Studies on mixing effectiveness
- Corrosion studies.
- Water chemistry, including chlorine demand and by-products



# Summary

- Although Electrical/Sonic barriers are very effective, they have holes that can allow AIS to migrate in both directions.
- A Chemical Treatment Chamber is a sound approach to address these holes
- Chlorine is a good choice for the chemical agent.
- A lock can be modified to be an effective design.
- The costs of such a system are reasonable.
- Several challenges identified
- Additional studies are recommended,
- There are no technical obstacles that cannot be overcome.